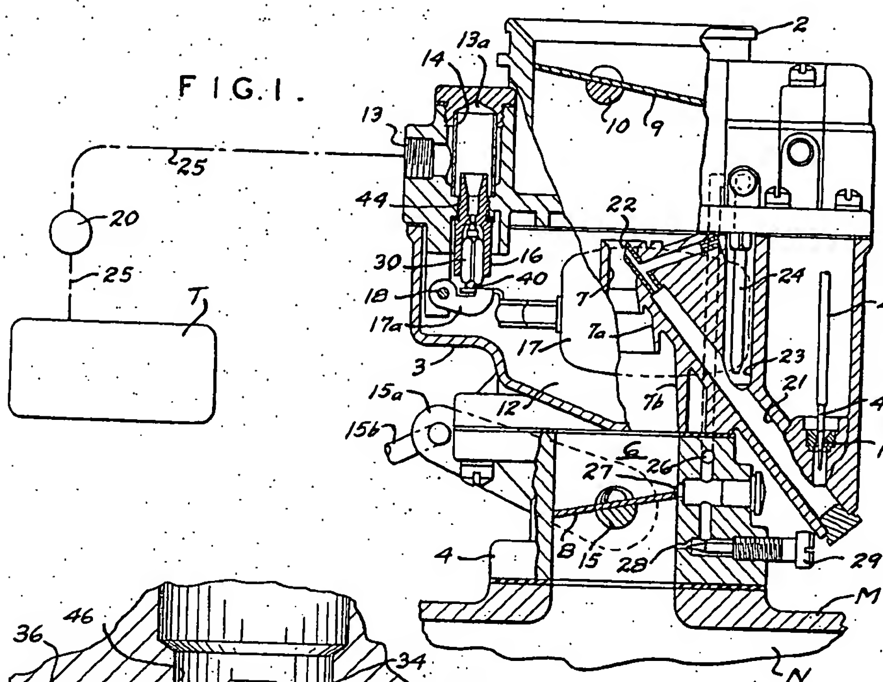
May 2, 1967 A. N. SZWARGULSKI 3,317,183

CARBURETOR

Filed April 29, 1964

FIG. 1.



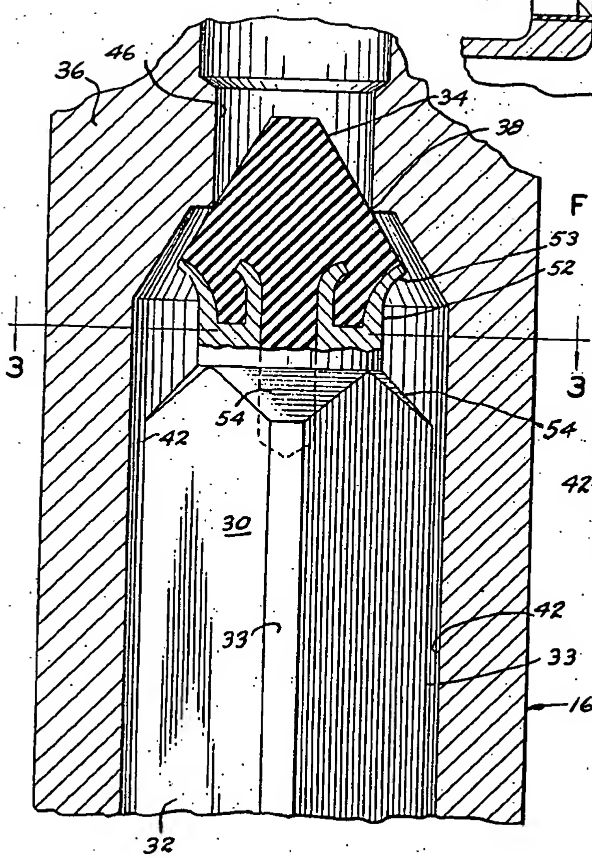


FIG. 2.

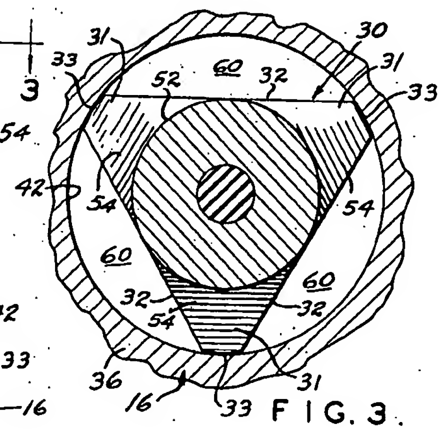


FIG. 3.

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BY [signature]

AGENT

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3,317,183
CARBURETOR
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4 Claims. (Cl. 251—120)

This invention relates to carburetors for internal combustion engines, and particularly to float actuated needle valves for maintaining a predetermined constant fuel level within a fuel bowl.

The valve needle is generally formed from triangular stock having a cylindrical neck portion formed at one end thereof and having a rounded portion at the other end for engagement with the float arm of the carburetor. A conical surface is formed on the cylindrical portion of the needle. The triangular needle is positioned for free reciprocation within a cylindrical bore in the valve body, the walls of the needle cooperating with the wall of the bore to define three fuel passages through the valve. The conical surface is engageable with a sharp circular valve seat defined in the valve body by a cylindrical bore forming a fuel inlet passage. Alignment of the conical needle tip with the circular valve seat and also the surface finish of the valve seat and needle tip are quite critical in the manufacture of needle valves. Correct alignment of the conical tip of the needle with the valve seat is maintained by three longitudinal guide surfaces which prevent axial tilting of the needle within the valve bore and which govern the relative positioning of conical tip and the valve seat. The surface finish of the needle tip and valve seat must be held within close tolerances because the valve tip and seat are small to prevent leakage of fuel due to surface defects. The fuel must be free from particles of foreign material which might interfere with proper seating of the needle. The flow path followed by the fuel as it flows past the needle valve and into the float chamber of most carburetors is generally tortuous and induces turbulence at several points along the flow path. Turbulence, swirling or eddying of the fuel in the fuel flow path sets up forces generally termed "back pressure," which oppose the flow of fuel and restrict the amount of fuel which will flow through the needle valve. A certain amount of turbulence is developed whenever there is a substantial change of direction in the flow of fuel.

Since larger and more powerful automotive engines are being developed which utilize larger portions of the available engine compartment volume of the automobile, a need has developed for accessories such as fuel pumps, carburetors, and the like, to be more compact in design. Since larger automobile engines require a greater amount of fuel than that required by smaller engines, a need has existed for the development of a carburetor with a reduction in overall dimension and yet an increase in the capacity of fuel flow.

It has been assumed that merely enlarging the needle valve seat and providing a larger conical surface on the needle would provide greater fuel flow. It was discovered, however, that an increase in the diameter of the cylindrical end portion of the needle would require an increase in the size of the triangular stock from which the needle is formed, thereby resulting in a needle of increased size and weight and increasing the cost of the needle by an amount such that the change would be impractical. It was further discovered that an increase in the size of the triangular stock would result in a decrease in the size of the flow passages defined between the needle and the bore in which the needle reciprocates, thereby restricting the volume of fuel flow. The bore in which the needle reciprocates, therefore, must be en-

larged to allow sufficient flow of fuel past the needle valve. An increase in the size of the bore in which the needle reciprocates would not only require an increase in the diameter of the valve seat but would also require lengthening of the bearing surfaces of the needle to control the alignment between the needle and the seat. Lengthening of the needle and the seat would result in a need for moving the pivot point of the float and for increasing the length of the float arm to establish an optimum engagement between the float arm and the needle valve. It is therefore, seen that merely changing the diameter of the cylindrical portion of the needle valve would result in a chain of changes tending to increase the overall size of the carburetor, thereby rendering such changes impractical.

It was found, however, that an increase in the valve seat diameter could be obtained by establishing a flare at the outer extremity of the cylindrical end portion of the needle valve, as illustrated in Patent No. 3,086,750 to Carlson et al., filed Feb. 2, 1961.

While the flared needle and enlarged valve seat structure allowed the flow of a greater volume of fuel, it was found that severe turbulence was induced into the flow of fuel immediately below the flare of the needle. As the fuel flows out of the fuel passage, through the valve seat and past the conical needle tip, severe turbulence or eddying of the fuel develops immediately below the flare. This turbulence or swirling fuel applies a force, generally called "back pressure," directly against the needle flare and opposes movement of the valve needle in the direction of the fuel flow. The net effect of the turbulence in the flow of fuel is to prevent an optimum amount of needle travel away from the valve seat and in effect limits the size of the opening through which the fuel may flow. It has also been found that turbulent flow of fuel, in the higher flow ranges, will become sufficiently violent to cause erratic oscillation of the needle within the needle bore. Erratic oscillation of the needle causes an erratic fuel flow when the demand for fuel by the engine is high. The engine may be starved for fuel and the maximum output of the engine may be reduced.

It is, therefore, an object of this invention to provide a novel carburetor needle valve structure which requires a minimum of space and yet which is adapted to provide a miximum fuel flow at a greater rate than can be consumed by the engine.

Another object of this invention resides in the provision of a novel carburetor needle valve, the operation of which is little affected by engine vibration or rough usage.

A further object of this invention resides in the provision of a novel carburetor needle valve structure during the operation of which the turbulence induced into the flow of fuel is minimized.

A still further object of this invention contemplates the provision of a novel carburetor needle valve construction wherein the tendency of the needle to oscillate during critical fuel flow periods is effectively prevented.

Other and further objects of this invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

Briefly, the invention is directed to a valve needle which is positioned for reciprocation within the valve body of a carburetor needle valve. The novel construction of the valve needle promotes efficient free needle travel within the valve body thereby allowing a greater volume of fuel to flow through the valve seat of the valve.

A preferred embodiment of the invention has been chosen for purpose of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein;

FIGURE 1 is a side elevation in several partial sections, illustrating a carburetor provided with a float actuated needle valve, embodying features of the invention.

FIGURE 2 is an enlarged fragmentary longitudinal section showing the needle valve structure of FIGURE 1.

FIGURE 3 is a transverse planned view of the needle structure of FIGURE 2, taken along lines 3—3 of FIGURE 2.

Referring now to the drawing, for a better understanding of the invention, a downdraft carburetor is shown in FIGURE 1 as comprising an air horn section 2, a main body section 3, and a throttle outlet section 4, said sections being secured together and forming a mixture conduit 6, having a stack of venturies 7, 7*a* and 7*b* in the main body section. The carburetor is mounted on the intake manifold M of a conventional internal combustion engine N, adapted for use in driving a vehicle.

A choke valve 9, operable responsive to intake air flow, is rotatably mounted in an unbalanced condition on a valve shaft 10 in the air horn section 2, which forms the air inlet end of the mixture conduit 6. A throttle valve 8 is rotatably mounted on a shaft 16 in the outlet end of the mixture conduit 6. Throttle shaft 15 is fixed to a lever 15*a* connected by means of a suitable linkage 15*b* to a manual control.

The main carburetor body section 3 is provided with a fuel bowl 12 having a fuel inlet 13 provided with a screen filter 14, fixed within an inlet recess 13*a*. A fuel inlet valve 16, includes a needle valve 30 having a tapered point 34 in contact with a valve seat of a valve body structure 36 to control fuel flow from inlet 13 into fuel bowl 12. A float 17 carries an arm 17*a* pivotally mounted at 18 within the fuel bowl to actuate the needle valve 30 for maintaining a substantially constant full level within the bowl 12. Fuel is supplied to the bowl from a fuel tank T by means of a conventional engine operated fuel pump 20 interposed in a fuel conduit 25 leading to the fuel inlet 13.

A fuel metering orifice 19 leads from the fuel bowl 12 to an upwardly inclined main fuel passage 21, having a main fuel nozzle 22, discharging into the primary venturi 7. Fuel flow from bowl 12 through orifice 19 into fuel passage 21 is controlled by a metering rod 40, having a stepped end 41 positioned in the metering orifice 19. Movement of rod 40 to position a different step portion in the orifice 19 provides a change in fuel flow through the orifice 19. An idle fuel system is shown as comprising a fuel well 23, leading upwardly from the main fuel passage 21. The well 23 has a metering tube 24 therein, communicating with an idle passage 26, provided by idle ports 27 and 28. The well 23 has a metering tube 24 therein communicating with an idle passage 26, provided with idle ports 27 and 28. An idle adjustment screw 29 is provided for the idle port 28.

The fuel inlet valve 16 includes the needle 30 formed with a body 32 of noncircular cross section (FIGURE 2 and FIGURE 3). One end of the needle 30 is formed with a conical tip 34, and the other end of the needle 30 is formed with a rounded head 40 for engagement by the float arm 17*a*. The needle 30 is formed with three ribs 31 each having a partial cylindrical guide surface 33 formed thereon which are in sliding engagement with the cylindrical bore 42 whereby the needle 30 is positioned for free reciprocal movement within a cylindrical bore 42 formed in the valve body 36. The upper end of the valve body 36 is formed with external threads 44, FIGURE 1, for detachable engagement within a threaded aperture leading through a wall of the carburetor to the inlet recess 13*a*.

While a vertically disposed needle valve incorporating a vertically reciprocal needle is illustrated in the drawing, this application is not limited to such construction. For example, the invention has been successfully employed in a carburetor having a horizontally disposed needle. In horizontally disposed needle valves, however, the force of gravity rather than aiding the needle in its downward movement, actually applies a slight force tending to retard needle travel. The opposing force of gravity in a horizontally disposed needle arrangement is so slight that it is substantially unmeasurable.

The valve body 36 is formed with a second cylindrical bore 46, coaxially aligned with the bore 42 and of smaller diameter. The bore 46 forms a shoulder 38, with the bore 42, to provide a valve seat for the tip 34 of the needle 30. The included angle of taper of the conical tip 34 of the needle 30 is from 60° to 90° for seating engagement against the sharp circular edge 38 of the valve seat.

In operation, fuel is forced by pump 20 from the fuel source or fuel tank T through fuel connections 25 and into the inlet 13 of the carburetor. Fuel will flow through the screening 14 and the fuel passages 46 and 42 past the needle valve 30, when the float structure 17 of the carburetor is in a downward position to release needle 30 from its fuel passage closing position. When the fuel bowl 12 is filled to the desired predetermined level, the float lever 17*a* will force the needle valve 30 against the valve seat 38 and close off further flow of fuel to the carburetor. During engine operation, fuel fills the main fuel passage 21 to the same level as within the bowl. Air flow through the mixture conduit 6 passes through the venturi stack 7–7*a*, causing a low pressure area at the mouth of the fuel nozzle 22. Atmospheric pressure on the fuel level in the fuel bowl forces fuel up to the fuel passage 21 and out of the nozzle 22 to mix with the air in the mixture conduit 6. The flow of air and fuel mixture into the manifold M of the engine is controlled in a well-known manner by the manually operated throttle valve 8.

As fuel flows from the fuel bowl 12 through the fuel passage 21 and the fuel nozzle 22, the level of fuel in bowl 12 is lowered, with a resulting lowering of the position of the float 17. The downward movement of float arm 17*a* permits the valve needle 30 to drop downwardly under the combined forces of gravity and fuel pressure to permit fuel flow from the inlet 13 into the fuel bowl 12 to replenish that used by the engine.

The tip 34 of the needle valve 30 may be formed of a synthetic rubber composition, such as Buna-N which is not effected by contact with fuel, as illustrated in FIGURE 2, or the tip 34 may be formed into a conical surface on one end of a needle valve, without departing from the spirit or scope of this invention.

The metal needle 30 is formed from metal rod stock having a triangular cross section, as shown in FIGURE 3. This specific needle stock size is given as merely illustrative rather than limiting in regard to this invention. Each of the ribs 31 is provided with a partial cylindrical guide surface 33 loosely fitting the bore 42 and serving to maintain the conical tip 34 of the needle 30 in correct alignment with the valve seat 38. A cylindrical neck portion 52 is formed at one end of the needle 30 and is disposed generally tangent to each of the generally planar side surfaces 32. The free extremity of the neck portion 52 is formed with a flare for receiving the conical tip 34.

In accordance with the invention, as illustrated in FIGURE 2, a chamfered transverse surface 54 is formed on each of the ribs 31 of the needle 30 by any appropriate method. Each of the surfaces 54 are generally planar and extend outwardly and downwardly from the neck portion 52 of the valve needle 30.

A number of advantages are produced by forming the surfaces 54 on the needle, each of which serves to promote optimum fuel flow through the valve. The direction of the fuel as it flows past the needle is changed very slightly thus preventing excessive buildup of back pressure which would oppose the flowing fuel. The fuel as directed by

the surfaces 54 to flow smoothly downward into the flow passages 60 defined by the surfaces 32 of the needle and the bore 42.

A large portion of the turbulence or eddying effect induced into the fuel, as it flows past the needle flare, is directed by the surfaces 54 to dissipate downwardly through the flow passages 60. Therefore, the forces produced by the turbulence induce a very small tolerable back pressure against the lower surface 53 of the flared portion of the needle. The needle will move a greater distance from the valve seat 38 thereby increasing the effective area of the seat opening and increasing the fuel output of the valve.

Since the violent turbulence in the fuel is substantially eliminated by the effect of the surfaces 54 upon the fuel, any tendency of the needle to oscillate erratically is also eliminated, and the needle valve will allow a high output and a steady flow of fuel.

The bearing or guide surfaces of a valve needle formed in accordance with this invention will be equally as long as the guide surfaces of a conventional valve needle having rounded shoulders because the chamfered surfaces 54 intersect the vertical guide surface 33 at the point of tangency of the curved surface, as illustrated in dash lines in FIGURE 2. An optimum guide surface length is, therefore, provided and there is no need for lengthening the needle body to maintain the required degree of alignment between the needle tip 34 and the valve seat 38.

From the foregoing, it is seen that I have produced a novel valve needle structure for a carburetor needle valve which, though it is not of larger design, effectively promotes a larger consistent fuel flow than has been obtained heretofore. The invention also effectively reduces the violence of the turbulence in the fuel flow immediately below the flare of the needle thereby reducing back pressure on the needle flare and allowing optimum needle travel and thus optimum fuel flow. The flow of fuel through the valve is subjected to a minimum of direction changes which effectively promote smooth and rapid fuel flow while inducing a minimum of turbulence in the fuel. The invention, therefore, is one well adapted to attain all of the objects hereinabove set forth, together with other advantages which are obvious and inherent from the description of the apparatus itself.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the appended claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. A fuel flow regulating device including,

(1) means forming a passage communicated with a source of fuel and having a seating shoulder formed therein,

(2) an elongated needle body longitudinally movably positioned in said means forming a passage, and

having side walls with opposed rear and forward ends,

(3) peripheral guide ribs on said elongated needle body for slidably engaging walls of said means forming a passage,

(4) a constricted cylindrical neck at the forward end of said needle body disposed adjacent to said shoulder and having a flared, tip receiving collar,

(5) a resilient flared tip received in said constricted neck at said collar, said tip having an outer conical surface for engaging said seating shoulder and forming a seal therewith when said needle body is urged toward said shoulder to prevent fuel flow through said means forming a passage,

(6) said resilient tip having a base at the lower part of said conical surface extending toward the walls of said means forming a passage to overhang said constricted cylindrical neck,

(7) means engaging said elongated body for movably positioning the latter in said passage to control the annular opening formed between said seating shoulder and said resilient tip, and

(8) a plurality of generally planar surfaces commencing at and extending rearwardly from said constricted neck toward the body rear end, and forming fuel diverting faces at said respective guide ribs to direct fuel along said body and thereby minimize fuel turbulence created when fuel passes through said annular opening and into the portion of said means forming a passage adjacent to said constricted neck.

2. In a fuel regulating device as defined in claim 1 wherein said respective guide ribs are equally spaced about the said body.

3. In a fuel regulating device as defined in claim 1 wherein said body includes a plurality of longitudinal flat sides, adjacent pairs of said sides being joined to form a juncture and define a guide rib.

4. In a fuel flow regulating device as defined in claim 1 wherein said body is formed of a flat sided triangular material forming three peripherally equally spaced guide ribs.

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